Quadratic Functions Applications

CA 8.0 Students solve and graph quadratic equations by using the quadratic formula. Students apply these techniques in solving word problems.

“Today you will be investigating/experiencing the quadratic function from real data and interpreting the graph’s x and y intercepts and its vertex.”

Warm Up/Guided Practice: 15 min
(a) Question using baseball application and graphing calculator
(b) Whole class debrief plus extension question: What if you would want to find out how far from home plate the ball dropped, how could you do this and where would that be?
(c) Segue into film clip from “October Sky” that makes use of the quadratic formula and rocket launch application. Clip ends humorously with “are you getting all that?”

Simulation/Application Lab: to help students understand a quadratic graph and its intercepts and maximum/minimum
(a) 5 min demo on lobbing tennis ball and group expectations:
   1.) How to lob ball
   2.) How to use post-it (students along ledge, look straight ahead and slap post-it in front of them at place where ball passes them
   3.) explain measurement is FROM the thrower who stands on the left side to emulate proper graphing.

(b) 25 min activity: teacher hands out lab sheet; students read to themselves; one student asked to summarize lab activity; teacher makes sure that # 3 and #7 are understood

Closure: Whole class debrief bringing lab activity back to warm up questioning
According to your function, how did you find the maximum point and what is it called on a graph? (y int/vertex)
Why is it a maximum and not a minimum?
How far from the thrower was the tennis ball when it hit the ground?
Graphically what did you find and what is this called?
(x-int/zero/root/solution) 6 min

Exit Slip to check student outcome 5 min
Create a New Lesson

School Site: __Samohi___ Grade/Subject: __Algebra II_____ Date: __Dec 2, 2008__
Topic/Lesson Title: __Quadratic Functions Applications__

Year-Long Goal/Lessons from Goal Setting:

Application of functions and their data

Teaching Point (Lesson Objective) for Today's Lesson: (specific lesson content/skill and California content standard. What do we want students to know/do by the end of the lesson?)

8.0 Students solve and graph quadratic equations by using the quadratic formula (factoring and completing the square). Students apply these techniques in solving word problems.

Students will be able to recognize a quadratic function and understand its intercepts and vertex by inputting data in a calculator and analyzing it.

One-sentence summary of what we will tell students regarding the Teaching Point or Lesson Objective?

You will be investigating/experiencing the quadratic function from real data and interpreting the graph’s x and y intercepts and vertex.

Our Instructional Strategy:

___demo ___guided practice ___inquiry ___explain and give examples ___lecture/discussion
_x__other simulation/investigation

Diagnosing/Fixing Confusion BEFORE our Lesson: (What immediately precedes this lesson? Are there any prerequisite skills? What do our students currently understand [or need to understand] about this topic?)
1. find vertex and x-y intercepts --use of Holt Practice B
2. use the graphing calculator: data entry/max/zeros
3. understand regression by using linear functions as review

Diagnosing/Fixing Confusion DURING our Lesson: (Where do we think students will get stuck? What will we say or do when our students get stuck?)

<table>
<thead>
<tr>
<th>Where students might get stuck</th>
<th>Fix-up Strategies (Build into the plan below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) input data in graphing calculator</td>
<td>1) provide students with a step-by-step how to sheet</td>
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</tbody>
</table>
DURING THE LESSON:

Teach (Developed lesson steps): Should include statement of lesson goal, connection to prior learning, sequence of lesson steps, examples, questions, problems, activities.

I. Warm Up 15 min
   (a) Question using baseball application and graphing calculator
   (b) Whole class debrief plus extension question: What if you would want to find out how far from home plate the ball dropped, how could you do this and where would that be?
   (c) Segue into film clip from “October Sky” that makes use of the quadratic formula and rocket launch application. Clip ends humorously with “are you getting all that?”

II. Simulation Lab to help students understand a quadratic graph and its intercepts and maximum/minimum 30 min
   (a) 5 min demo on lobbing tennis ball and group expectations
   (b) 25 min activity

III. Whole class debrief bringing lab activity back to warm up questioning
   According to your function, how did you find the maximum point and what is it called on a graph? Why is it a maximum and not a minimum?
   How far from the thrower was the tennis ball when it hit the ground?
   Graphically what did you find and what is this called? 6 min

IV. Exit slip to note students’ understanding of the y-intercept for their simulation and in real world terms. 5 min
**Guided Practice:** (students try it out with teacher assistance/support)

**Warm Up segment is the mini-lesson/guided practice for the lesson**

**Application:** (students try it out on their own)

Lab simulation makes use of groups of 4 who join with another group of 4 to increase the data entry. They do an activity that makes use of a tennis ball throw that emulates a parabolic graph. They input data points to graph on a graphing calculator and then interpret their intercepts.

**Anticipated Student Responses:** (What kinds of responses can I anticipate from my advanced, on-grade-level, and below-grade-level students?)

<table>
<thead>
<tr>
<th>Prototype Response (e.g., Shutdown Sally)</th>
<th>Anticipated Student Response (What might the student say/do?)</th>
<th>Teacher Response: What can the teacher say/do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mitch the Mooch</td>
<td>Waits for group to do all of the work</td>
<td>Teacher circulates and asks Mitch to explain the answer on his paper.</td>
</tr>
</tbody>
</table>

**Checking in (during independent or group work):**

**Closure:** (reinforce the original lesson goal and connect today's work to tomorrow's lesson)

Whole Class debrief after lab activity is the closure segment.

“Today, you experienced the creation and graphing of a quadratic function and interpreted the points its graph: max/min point; x and y intercepts”

**ACTION ITEMS:**

**Student Outcomes/Evidence to Collect:** (How will we document student learning, e.g., student work, verbal responses, observation? How will we know all students "got it," not just the ones who answered our questions? What criteria will we use to measure mastery? [e.g., sample paper, rubric])

Document student interactions, teacher-student questions/responses, and exit slip to gauge mastery of understanding of y-intercept i.e. the one new learning from this simulation.
<table>
<thead>
<tr>
<th>Materials/Preparation Needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>*film clip from “October Sky” 1999 film directed by Joe Johnston</td>
</tr>
<tr>
<td>*yard sticks</td>
</tr>
<tr>
<td>*post-its</td>
</tr>
<tr>
<td>*tennis balls</td>
</tr>
<tr>
<td>*lab sheet with directions and guiding/probing questions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schedule for teaching/debriefing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1: <strong><strong>Holly per 1</strong></strong>_____</td>
</tr>
<tr>
<td>Debrief 1: _<em>per 1 Geoff’s room next day</em></td>
</tr>
<tr>
<td>Lesson 2: <strong>Marae per 2</strong>_________</td>
</tr>
<tr>
<td>Debrief 2: <strong>Marae’s room per 3</strong>___</td>
</tr>
<tr>
<td>Lesson 3: <strong>Geoff per 6</strong>_________</td>
</tr>
<tr>
<td>Final Debrief: __after school Geoff’s room</td>
</tr>
<tr>
<td>Pre-plan for cycle 2 per 4-lunch Geoff’s room; per 5 prep period-library/Holly’s room</td>
</tr>
</tbody>
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<tr>
<th>Follow-up instruction:</th>
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</table>
WARM UP

The path of a baseball after it has been hit is modeled by the functions \( h = -0.0032d^2 + d + 3 \), where \( h \) is the height in feet of the baseball and \( d \) is the distance in feet the baseball is from home plate. Use your calculator to help.

What is the maximum height reached by the baseball?
How far is the baseball from home plate when it reaches its maximum height?
WARM UP  teacher notes

The path of a baseball after it has been hit is modeled by the functions \( h = -0.0032d^2 + d + 3 \), where \( h \) is the height in feet of the baseball and \( d \) is the distance in feet the baseball is from home plate. Use your calculator to help.

What is the maximum height reached by the baseball?  
How far is the baseball from home plate when it reaches its maximum height?

Extension Question that then segues into film clip:  
What if you would want to find out how far from home plate the ball dropped, how could you do this and where would that be?

**Best calculator screen:**  \(-10 \leq x \leq 400 \) (40’s) \quad \(-10 \leq y \leq 100 \) (10’s)  
**Students identify best calculator window/ teacher prompts while noting pacing**

**Vertex is** (156.25, 81.125)  

**Zeros are at** (315.472, 0) and (-2.972, 0)  
This would not exist since the ball has been hit and the parabola starts
In 1957, the Russians launched the first satellite into space. Its name was Sputnik and it inspired different emotions in different Americans. Some were scared, some were in awe, and some just wanted the Americans to catch up with the Soviets. In this movie Jake Gyllenhaal plays a high school boy from a small coal mining town who is inspired to launch a rocket of his own, with the help of some of his friends.

A major problem arises when the kids are accused of starting a forest fire three miles from their launch site. Since they cannot account for all of the rockets that they launched, the accusation sticks and Gyllenhaal’s character is thrown out of school. In this scene, Gyllenhaal returns to the school having found the missing rocket and ready to defend himself to the principal.
Instructions for Data Entry and Regression on TI 83+  
HOW TO: graphing vertex (max/min)  
And intercepts

To start you need to make sure to **Clear All Lists**:

1) Turn ON calculator

2) Go to MEMory

3) Arrow down to #4 ClrAllLists

4) ENTER to Clear All Lists. Done.

Then you need to turn on the **Statistics Plot**:

1) Go to STATPLOT

2) The cursor should be on Plot 1. That is what we want.

3) The cursor will be blinking on “On”. That is what we want. “Off” will no longer be “highlighted” black.

4) Be sure that: “Type” is a dot pattern (It should be highlighted.); Xlist: L1; Ylist: L2; and Mark □.

5) The Statistics Plot is all set up. QUIT out.

Now we need to set the WINDOW to our data:

1) Go to WINDOW

2) Xmin should be about 5 less than the smallest entry in the list of independent data. Xmax should be about 5 more than the largest entry in the list of independent data. Choose the best scale for your independent data (by 1; 5; etc.) and enter that for Xscl. Continue to Ymin, Ymax and Yscl for the dependent data. QUIT out when finished.
### Instructions for Data Entry and Regression on TI 83+

**HOW TO: graphing vertex (max/min) And intercepts**

Now we are ready to enter our data into a List:

1. **Go to STAT**

2. **We want to “Edit” a list. The cursor should be there.**

3. **We want to start with List 1. The cursor should be on the first line of L1. If not, arrow over until it is.**

4. **Start entering the independent data into L1; pressing ENTER after every entry.**

5. **When finished with the independent data, ENTER the dependent data into L2. Arrow over to get to the next list. Press enter after every entry.**

6. **The data is all entered. QUIT out.**

Now we need to find the function that best fits the data:

1. **Go to STAT**

2. **We want to “CALCulate” the regression, so arrow over to CALC.**

3. **Choose the Regression that best fits your data. Arrow down OR choose the number.**

4. **We must tell the calculator what data to use for the regression. We want “L1” as the independent. . . indicate a separate with a comma (above the 7 key). . . “L2” as the dependent. . .**

5. **Then it needs to graph the function once calculated. We tell it to use which VARIable (Y-VARIable) as a “Function” (the cursor should be there) as “Y1” (the cursor should be there). . .**

6. **Now it is ready to calculate. . . enter twice! The first time gives the coefficients, the second time enters the equation. . .**

6. **You are then ready to see your graph!**
Quadratic Simulation

Purpose: To calculate the quadratic function to represent the path of a tossed ball.

Materials:

- Tennis Balls
- Post-it notes
- Yard sticks
- Wall

Groups: 4 students per group

Procedures:

1. Pair up with another group so there are a total of eight people for data collection.
2. Designate the roles of one thrower and the seven data collectors.
3. The seven data collectors position themselves facing the wall standing ideally two feet apart from each other with a post-it in hand. (Hint: It may be helpful to position the taller group members in the middle of the data collectors.)
4. The designated thrower stands on the left side of the wall and gently lobs the ball with their hand closest to the board (left hand) in order to get a parabolic arc.
5. As the ball passes, each person marks the ball’s position with the post-it note immediately as the ball passes in front of them.
6. Measure the height of each post-it note with respect to the ground.

The thrower measures the horizontal distance while each student measures the height of post-it

7. On each individual’s post-it note, write down the point on the parabola which it represents. The independent variable, or x-coordinate, represents the position of the data collector from the thrower. The dependent variable, or y-coordinate, represents how high the post-it note is off the ground.
8. Record the points of the data set in the table below.
9. Return to the original group of four members to analyze the data.

Data:

<table>
<thead>
<tr>
<th>Distance from Thrower (in inches)</th>
<th>Height of the Ball (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>
Data Analysis:

1. Use your data to calculate the quadratic regression equation. Round to 3 decimal places

2. According to your regression equation, what was the maximum height the ball reached?

3. According to your regression equation, how far from the thrower was the ball when it reaches its maximum height?

4. According to your regression equation, how far from the thrower was the ball when it hit the ground?
Exit Slip

1. What is the value of the y-intercept for your simulation?

2. What does the y-intercept represent in real world terms?